

Rhode Island Marine Technology and Aquaculture Center

Project Development and Economic Feasibility

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Timothy M. Scott	Director, Center for Economic and Environmental Development Roger Williams University
David Alves	Aquaculture Coordinator Rhode Island Coastal Resources Management Council
David Bengtson	Professor, Fisheries, Animal and Veterinary Science University of Rhode Island

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A copy of this report and appendices can be found at the CRMC web site:

<http://www.crmc.state.ri.us>

1. Executive Summary

This report outlines the rationale and potential for the development of a **Marine Technology and Aquaculture Center (MTAC)** to attract and support start-up marine biotechnology and aquaculture companies in Rhode Island. At present, Rhode Island, the *Ocean State*, makes only a minor contribution to the annual \$1 billion U.S. Aquaculture Industry, ranking at or near the bottom among all States in terms of aquaculture production. The State also lacks any commercial production in the marine biosciences, an area of economic interest and growth potential.

These industries typically rely on access to flowing seawater and limitations to their expansion are well documented. These include: 1) regulatory issues and user conflicts, 2) predation and disease, 3) access to financial capital, and 4) water quality. As it stands now, each potential company must find a suitable waterfront location, argue their case individually to permitting boards and include water flow and filtration systems into their capital expenditures. Securing financing can be difficult as traditional lenders and investors are unfamiliar with the industry needs and potential and are justifiably concerned about providing capital. The establishment of a support facility such as the Marine Technology and Aquaculture Center (MTAC) proposed here would be expected to help mitigate most of these limitations. MTAC proposal is based largely on existing facilities in Florida (Harbor Branch Oceanographic Institution) and Hawaii (Natural Energy Laboratory of Hawaii Authority). It is envisioned as a land-based, multi-acre facility housing technical, business and legal expertise and offering laboratory, office and greenhouse space, flowing seawater and the necessary operating permits to attract and support marine biotechnology and aquaculture companies. At present, no such facility exists to promote the development of these industries in the Northeast.

We approached this study with the idea that MTAC would be a distinct corporate entity that would provide needed industry services, but focus primarily on business incubation. A design study relying on recirculation technology was undertaken by Marine Biotech, Inc of Beverly MA; a preliminary marketing study was done by Dr. Amy Tomas of Roger Williams University and the Principal Staff at Harbor Branch served as consultants to the project. Kevin Hively of Ninigret Partners, LLC served as our principle financial consultant.

While MTAC is a sound idea, the financial analysis of the project as currently envisioned suggests that a free standing facility is not likely to be sustainable. Annual operating costs and amortization of capital expenditures would not be met by simple lease and service arrangements described here. There is a demonstrable need for the services that MTAC would provide, however the corporate structure as envisioned does not appear to be viable without ongoing subsidy.

What has evolved from this original idea is the concept that for this to work, the facility would need to be much larger in scale than the one proposed here, and should alter its focus to incorporate both research efforts and industry development. The

recommendations of the financial consultants hired for this study are that MTAC should be positioned as a marine research and development facility with business incubation capabilities. This would open the market to marine researchers in both academia and private corporations and provide for the possibility of securing federal research funds. There appears to be a market niche for such a facility in New England.

This model is currently being examined through an expanded marketing study looking at the viability of a Marine Biosciences and Aquaculture Testing Facility. Support for this expanded project is coming from university and government sources that include the RI Coastal Resources Management Council, the RI Economic Development Corporation, the Slater Center for Marine and Environmental Technologies, Roger Williams University, the University of Rhode Island and Brown University.

2. Introduction

Marine Biotechnology is the application of scientific and engineering principles to provide goods and services through the modification of biological agents. Research has shown the potential for exploiting the biochemical capabilities of marine organisms to produce new classes of pharmaceuticals, polymers, enzymes, chemical products, and industrial processes as well as vaccines, diagnostic and analytical reagents. Biotechnology depends on exploiting information stored in genes and, until recently, the genes of terrestrial organisms have been the primary source of information for the products and bio-processing methods that form the foundation of biotechnology. While terrestrial organisms exhibit great species diversity, marine organisms represent great phylogenetic diversity. That is – most of the major groups of the Earth's plants, animals and microorganisms are primarily or exclusively marine. Thus, marine species represent unique sources of genetic information and important natural resources for development.

Rhode Island has an abundance of clean water, and a cadre of research scientists focusing on marine biotechnology. What we lack is a streamlined process that addresses the specialized needs of those academic researchers and entrepreneurs who wish to expand upon their findings, develop products for market introduction and grow a profitable business entity. This has been recognized within the State, with one response being the establishment of the **Samuel Slater Technology Fund**, and the operation of the various **Slater Centers** (e.g., marine and environmental technology) to support and promote the commercialization of cutting-edge technology. What remains lacking, however, is access to a state-of-the art facility that provides an entrepreneurial environment supporting and encouraging the development of research findings into marketable products. In turn, this will create more jobs, diversify the state's economic base and ultimately add to Rhode Island's revenue stream.

Aquaculture is the commercial production of aquatic plants and animals under controlled conditions. On a global scale, this industry accounts for about 27% of total seafood production, and is an active area of economic growth and job creation. Since 1970, aquaculture production has increased at a compounded rate of 9.2% annually compared with 1.4% for the capture fisheries and 2.8% for terrestrial farmed meat production. In 2000, 45.7 million metric tons of cultured product was sold worldwide with a value of US \$56.5 billion. Domestic production recently reached US \$1 billion and represents about 2% of global production. The United States is the largest single market for cultured seafood product (*State of the World Fisheries and Aquaculture*, FAO 2002). The aquaculture industry in New England has grown from essentially nothing in the late 1970's to about \$150 million in annual production. The industry is diverse and includes several species of finfish, shellfish and even algae. Rhode Island supports a small but growing group of shellfish producers, who collectively hold 18 aquaculture leases covering 54 acres of bottom (*2002 RI Aquaculture Status Report*, CRMC). This is very different from the ~20,000 acres of Narragansett Bay that were held under private lease early in the last century when Rhode Island was among the largest producers of cultured shellfish. Today, the annual farm-gate value of aquaculture product in Rhode Island is

about \$400,000. Not only does Rhode Island (the *Ocean State*) trail the region, but also ranks at or near the bottom among all States in terms of production.

The Rhode Island Legislative Commission on Aquaculture, chaired by Representative Eileen Naughton, commissioned a study in 1998 that identified four main areas limiting the growth of the aquaculture industry. These were: 1) regulatory issues and user conflicts, 2) predation and disease, 3) access to financial capital, and 4) water quality. By its very nature, aquaculture has operating requirements not found in traditional brick and mortar industries. Depending on the market segment, these may include such things as obtaining permits and leases for the private use of public water rights, the engineering of systems for harsh aquatic conditions, on-going water quality testing, disease screening, and a continuing need for scientific expertise and technical support. As it stands now, each company must find a suitable waterfront location, argue their case individually to permitting boards and include water flow and filtration systems into their capital expenditures. Securing financing is often difficult as traditional lenders and investors are unfamiliar with the aquaculture industry and are justifiably concerned about providing capital to an industry that is so dependent on nature.

It is our contention that these concerns can be largely overcome through the establishment of a regional Marine Technology and Aquaculture Center (MTAC) to serve as an industry resource and business incubator. As envisioned, MTAC will be land-based and rely largely on recirculation technology. This means that conflicts with other users of the bay will be minimized. All operating permits will be in place; predators and disease organisms will be carefully monitored and adequate water flow and water quality assured. Perhaps most importantly, within such a nurturing environment, financial institutions should be far more likely to provide capital to fledgling companies and support the growth of the industry.

Ancillary Business Opportunities Rhode Island is home to numerous companies that provide products and services to the aquaculture industry. This industry segment includes companies that distribute live cultured product and those that manufacture and distribute equipment used industry-wide. The need for such equipment grows in step with worldwide aquaculture production. Collectively, these local companies had approximately 24 full-time employees in 2002, and generated a gross revenue of about \$4.3 million – a 10% increase from the previous year. Continued support and development of these aquaculture related products and services present substantial economic opportunities for the state of Rhode Island.

Study Objectives The funding from the Rhode Island Aquaculture Initiative to explore the feasibility of a Marine Technology and Aquaculture Center reflects the support of state and federal legislators, and their commitment to economic development and technology transfer. This document will 1) explore the feasibility of creating a marine technology and aquaculture center to serve the region and, 2) identify issues and costs associated with building and sustaining a center that will provide a supportive and secure environment in which to carry out research and product development initiatives. Appended to this report are 1) an overview of Rhode Island's aquaculture industry; 2) the complete results from the marketing study conducted during 2002; 3) a facility design study generated by the firm of Marine Biotech, Inc of Beverly, MA.

This study serves three primary purposes:

- ◆ Articulate the feasibility of a marine technology and aquaculture center to potential funding sources, customers and/or investors.
- ◆ Project financial expectations, including underlying assumptions, to demonstrate the feasibility of the proposed facility.
- ◆ Summarize the operational and management details of the proposed facility.

Technical Expertise Used in the Study The intent of this study was to determine the feasibility of developing a land-based Marine Technology and Aquaculture Center in Rhode Island. At present, only two facilities of similar scale and scope are operating in the United States. The first is the 500 acre Natural Energy Laboratory of Hawaii Authority (NELHA) located near the town of Kailua-Kona on the Big Island of Hawaii (visit <http://www.nelha.org>). This facility began in 1974 as a Federal energy research site, but now serves primarily as an aquaculture development facility with 30 corporate tenants that collectively generate between \$30-\$40 million annually. This facility is unique in that it draws cold, nutrient rich water from the deep ocean. Because of the site-specific nature of this water source, this technology and design could not be replicated in New England. More appropriate to this proposal is the Aquaculture Development Park operated by the **Harbor Branch Oceanographic Institution (HBOI)** of Fort Pierce, Florida (visit <http://www.hboi.edu>). Recognizing that the growth of aquaculture was limited by the availability of land and water use restrictions, HBOI opened this versatile 60-acre facility on its campus in 1997. Aquaculture companies either lease space or form a partnership with HBOI and use the site as an incubator to try out new ideas and/or develop new markets. As companies grow, they may continue to operate commercially out of HBOI or establish off-campus locations. Both Dr. Megan Davis, current Director of the HBOI Aquaculture Division and Dr. David Vaughan, former President of three subsidiary companies that had their start at HBOI, served as consultants to our project. As no such facility exists to serve the New England region, both have been supportive of our plans to develop MTAC in Rhode Island.

A marketing survey of our proposal was conducted during the summer of 2002 by Dr. Amy Tomas of the **Gabelli School of Business** at Roger Williams University. Her findings are summarized below, with the full report attached as an appendix. Engineering expertise for this project was provided by **Marine Biotech, Inc.** (MBI) of Beverly Massachusetts. This company is a leading supplier of aquatic holding systems to public aquaria, the commercial seafood industry, the academic research community and the aquaculture industry. Marine Biotech Inc. provided technical assistance with regard to the specialized water intake/filtration/discharge system required for a facility of this type. A full copy of their report is also attached to this document. Additional market research, financial analysis and an overview of the MTAC concept was conducted by the firm of **Ninigret Partners, LLC** of Providence, RI.

3. Operating Parameters

Engineering Study A specific site for establishing the Marine Technology and Aquaculture Center has not been identified. It will be necessary to locate the facility within easy access of a high quality source of seawater (Class B or higher), and obviously the cost of land acquisition will be critical in the final analysis of the project. The preliminary design criteria that we have established is for a water supply system that relies heavily on existing recirculation technology. With nutrient discharge a fundamental problem in aquatic ecosystems, we have specified a water treatment protocol that relies on the reuse of system water, with full treatment of both incoming and discharge water. The intent is to limit the potential discharge of nitrogen and phosphate to Narragansett Bay. With this in mind, we contracted with Marine Biotech Inc. to design a multi-unit, expandable facility with a maximum seawater intake of 225 gallons per minute (gpm). This is not a large flow rate for a facility of this size, however open system cultivation is never likely to be an acceptable practice for land-based aquaculture in Rhode Island. The 225 gpm therefore represents the 10% water change per day that is typical in recirculating systems, and the total amount of standing water that could be available for use in this facility will approach three million gallons. Large storage reservoirs are part of the plan in order to accommodate a short-term shutdown of seawater intake that might result from storms or other water quality issues.

Marine Biotech Inc. developed their preliminary proposal to address the intake, discharge and distribution requirements to assure the availability of a constant supply of clean seawater for the proposed facility. Seawater intake, pre-filtration, storage capacity, consistent pressurized delivery and discharge treatment capacities were addressed in this proposal. The technical report includes data on preliminary system design, required equipment and materials, system installation and associated preliminary estimates for the various elements of the system. Based on our design criteria, financial analysis and costs provided by MBI in their preliminary report dated August 29, 2002, it is estimated that system design, delivery of system components and installation will amount to **\$1,230,000**. A great deal of variability should be assumed in this figure as site-specific criteria can be expected to affect the cost of the water handling infrastructure.

Buildings and Infrastructure At a minimum the facility should include a 8,000 ft² main structure of which 2000 ft² will house the management and support staff. This will also include space for shared secretarial and mailroom resources, a shared kitchen and conference/seminar room. The remainder of the main building (6000 ft²) will consist of versatile and reconfigurable space that can be modified and leased to interested parties as required. This might include office and/or laboratory space (dry and/or wet) that can be leased to individual researchers, established businesses or start-up companies requiring access to a clean, reliable source of seawater. To start, the facility should include 4-6 greenhouses of approximately 1800 ft² each, with space allocated for additional greenhouses as needed. Construction for the main building is estimated to cost approximately **\$1,092,000** (at \$130 per ft²). The four greenhouses are budgeted at \$30,000 each (total of **\$120,000**) based on cost estimates associated with recent local construction.

4. Marketing and Potential MTAC Clients

Positioning MTAC for long-term success depends on a significant on-going dialogue with the marine technology and aquaculture communities. This dialogue helps identify potential clients and also ensures that MTAC is designed to meet client needs. Initial steps to achieve these goals has been taken by gathering information from industry experts in two ways: 1) a market research study soliciting information from informed individuals involved with Rhode Island aquaculture, and 2) a structured analysis of the Aquaculture Development Center at Harbor Branch Oceanographic Institute with input from principals at that facility. The full initial marketing study *Marine Technology and Aquaculture Center Key Consumer Perception Study*, September 1, 2002 is attached to this report. The four key findings are summarized as:

Perceptions of the Concept and Potential Contributions: The survey revealed that the majority of the “key consumers” believe that the Center is “a great idea” while expressing, at the same time, a desire for clarification of the “...focus for center tenants [and] unique benefits...” of the Center. Respondents viewed the potential, and potential contributions, in two ways: What it could bring to the industry, and what might occur without it. Possible contributions included aquaculture and bio-technology “support services and goods ... worldwide” and significant assistance to start-ups. Without a technology Center, most felt that Rhode Island would continue “the course we are on ... no growth, more legal problems.”

Proposed Product Offerings: The expert audience expects MTAC to provide business tenants with critical resources – clean water, renewable energy sources, relevant permits (secondly) adequate waste management programs and (thirdly) marketing and business planning assistance. A wide range of educational services – internships, public education, workshops, classroom facilities – were advocated by the respondents.

Identifying Tenants: Research provided insight into marketing channels and methods for acquiring potential tenants. A number of suggestions were focused – work with a specific institution to develop referrals – while most were of a standard, shotgun media awareness, approach.

Harbor Branch (HBOI) Research: HBOI has operated an Aquaculture Development Center of its own origination since 1997 and provided insight into what they believe has worked and what didn't work, as well as surprises encountered. HBOI appears to have followed the following path: 1) Assess industry needs and match HBOI resources to verified needs. 2) Examine the gap between technological research success and financial success. 3) Document reasons for lack of commercial success to determine whether HBOI could fill significant gaps. 4) Determine whether identified gaps could be filled at an acceptable cost by HBOI. Two significant HBOI findings, useful to this study, were time spent between idea inception and physical production and lack of skills by needed production staff. HBOI felt that the existence of a standing facility, staffed to provide core services, addressed these critical issues. HBOI shared their general experiences regarding tenant acquisition, retention, success and problem resolution. This information will be extremely useful in shaping the Center marketing effort. HBOI also identified the need to provide business resources to tenants that had had “all of the technical, logistical and permitting” problems solved for them.

5. Operations

The concept behind the Marine Technology and Aquaculture Center is to provide the fundamental resources required by a startup aquaculture or marine biotechnology company. It is anticipated that organisms will largely be indigenous, or at least pose no local environmental danger (e.g., tropical species that could not survive in local waters, and/or acceptable technological protocols that ensure no release). Individual requirements of corporate tenants can be expected to vary considerably and the services offered will need to be tailored to the needs of the particular company. When HBOI opened the Aquaculture Development Park in 1997, they quickly had twelve companies on site of large, small and intermediate size. The arrangements ranged from a simple lease of greenhouse space to having HBOI Staff running the production side of a company while the outside partners focused on marketing. Some ventures failed, others succeeded and several were subsequently taken over by HBOI and are now running profitably. To achieve success, the HBOI facility needed to be versatile and responsive to the varied needs of its corporate tenants. The operating principles of MTAC will need to include a level of versatility if it is to succeed.

At a minimum, operating permits, a reliable source of clean flowing seawater, and waste treatment and management (e.g., nitrogen removal and discharge permits) should be provided. This would allow an interested company to take space on an almost turn-key basis and begin operation without the usual delay of permitting and site selection. Many of the other resources required by a startup company could be shared and partitioned according to need. For example:

Level 1 Services could include water supply and the lease of space in a greenhouse, the wet laboratory, offices and/or a dry laboratory. Additional services provided could include a shared secretary, access to a shared conference/seminar room, mailroom and photocopying services as well as use of restrooms, kitchen and break space.

Level 2 Services could extend access to shared laboratory resources such as PCR machines, high quality microscopy (e.g., fluorescent microscopes), -80° freezer storage or incubation chambers. Items such as these (which tend to be expensive) could be contained in a general use room which, depending on the resources of the individual company and their sensitivity to proprietary ideas, could be shared among tenants. This level may also include access to a chemical stock room. This would not preclude a company from setting up their laboratory space as they see fit.

Level 3 Services would be those provided on a per fee basis, such as environmental testing, business or legal services. Direct operational support from MTAC Staff would also be available at this level of service.

The concentration of resources, expertise and industry in a relatively small cluster can be expected to generate synergistic effects as partners interact with each other. It would be possible to expand this cluster idea by locating some state, regional and/or national aquaculture and marine biotechnology resources at this same location. For example, at the Federal level, a USDA or Sea Grant Office might be well suited for inclusion at this location. The state might consider locating the CRMC Aquaculture Coordinator and perhaps one of the Slater Centers at the facility.

6. Operating Permits

In June, 2002 a meeting was held at the RI Department of Environmental Management in Providence to review permitting issues associated with the operation of a Marine Technology and Aquaculture Center. Attendees included David Alves, Aquaculture Coordinator from the Coastal Resources Management Council (CRMC), Angelo Liberti and Eric Beck from the Office of Water Resources, Chris Powell from the Division of Fish and Wildlife and Ron Gagnon, Office of Technical and Consumer Assistance. It was determined that at least three permits will be required from the Department of Environmental Management: a **Special Permit for Aquaculture** issued by the Division of Fish and Wildlife, a **RI Pollution and Discharge Elimination System (RIPDES)** Permit issued by the Office of Water Resources, and a **Water Quality Certificate** issued by the Office of Water Resources. It was determined at the meeting that, in the Department's opinion, permitting for a Marine Technology and Aquaculture Center as described was feasible. A letter to this effect was sent to the Principle-Investigators by Ronald Gagnon, Chief of the Office of Technical and Customer Assistance, and is attached.

7. Management

It is projected that, initially, a limited number of staff will be responsible for management and operation of the marine technology and aquaculture center. Key management personnel include: 1) **Center Director:** With overall responsibility for the management of the Center, this person be able to work with tenants and have a working knowledge of aquaculture and marine biotechnology. 2) **Technical Support:** MBI estimates that one full-time or two part-time technicians will be required to support daily service and maintenance of the water intake/filtration/discharge systems. This individual needs knowledge of the water system and be able to maintain, service and alter these systems as required. 3) **Office Administrator:** Initially this could be a half-time position until the tenant base justified expanding to full time.

8. Feasibility Analysis and Recommendations

The MTAC Financial Feasibility Analysis was conducted by the firm of Ninigret Partners, LLC of Providence, RI and undertaken by Mr. Kevin Hively in the spring of 2003. In addition to estimating the financials of the original MTAC concept, Mr. Hively undertook a more detailed and thorough market analysis of the concept, which has helped to provide focus and direction to this effort. As you can see from this analysis (Appendix 1), the financial projections for the original concept of a stand-alone, multi-acre marine business incubation facility are not favorable. Even if capital costs were to be provided at the outset and land attained at no cost, the operating costs of such a facility are unlikely to be met by the basic income streams of leasing space and services. Additional sources of revenue will be needed, or the operating management will need to have the versatility and expertise to invest in participating companies. This is the model that Harbor Branch Oceanographic currently operates under, but this approach is not recommended.

Limitations to the MTAC facility outlined here include the size originally envisioned and the emphasis that it placed on business incubation. What has been realized from the efforts undertaken in this study is that in order for this concept to work, the facility needs to be larger than the one proposed, and should alter its focus to incorporate both research efforts and industry development. The recommendations are that MTAC should be positioned as a marine research and development facility with business incubation capabilities. This would open the market to marine researchers in both academia and private corporations and provide for the possibility of securing federal research funds. There appears to be a market niche for such a facility in New England.

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